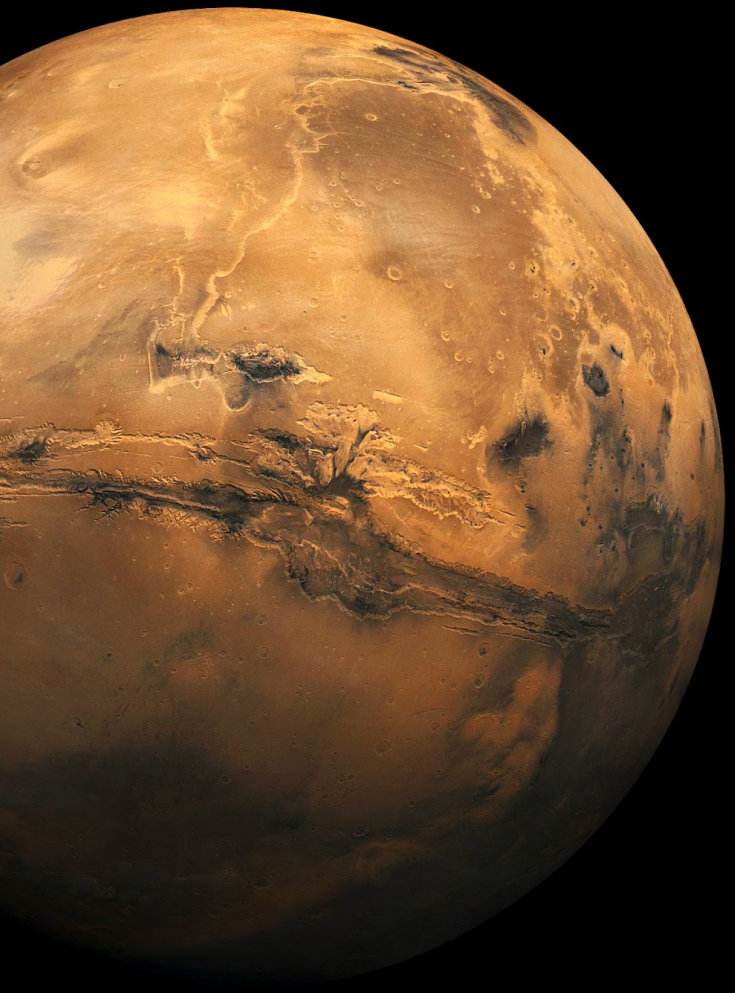
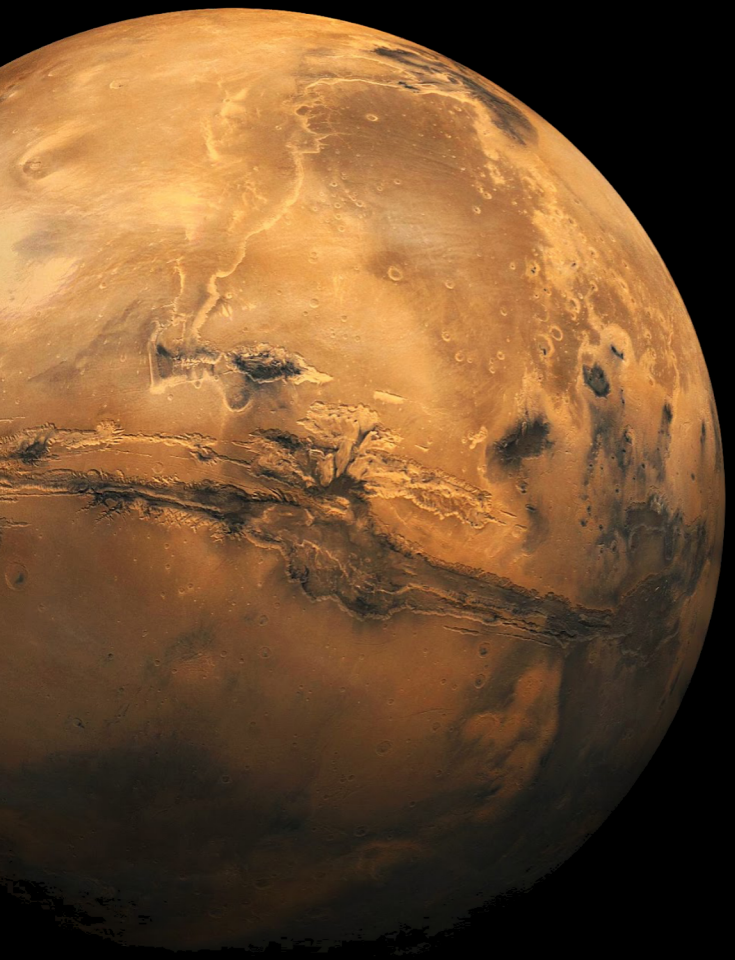
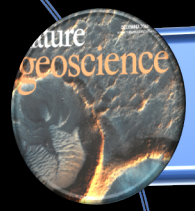


AEROBIC SUBSURFACE MARS

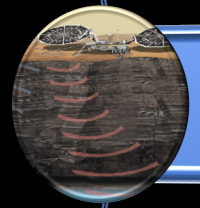
Vlada Stamenković
NASA Jet Propulsion Laboratory, California Institute of Technology

Michael Mischna (JPL), Lewis Ward (Harvard), Woody Fischer (Caltech), Doris Breuer (DLR), Ana Plesa (DLR) & the VALKYRIE Team.

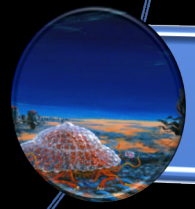




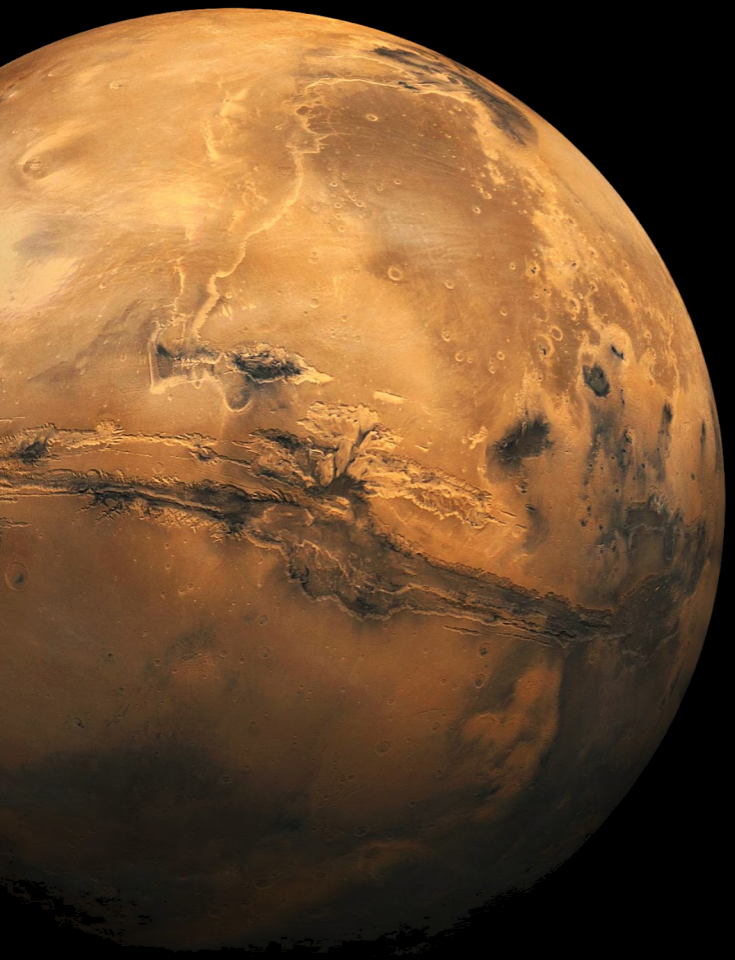
Aerobic Mars?

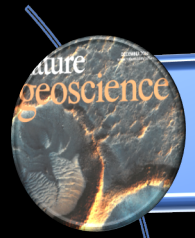


How to explore it?



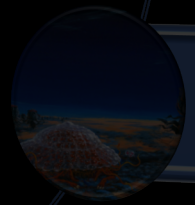
Summary





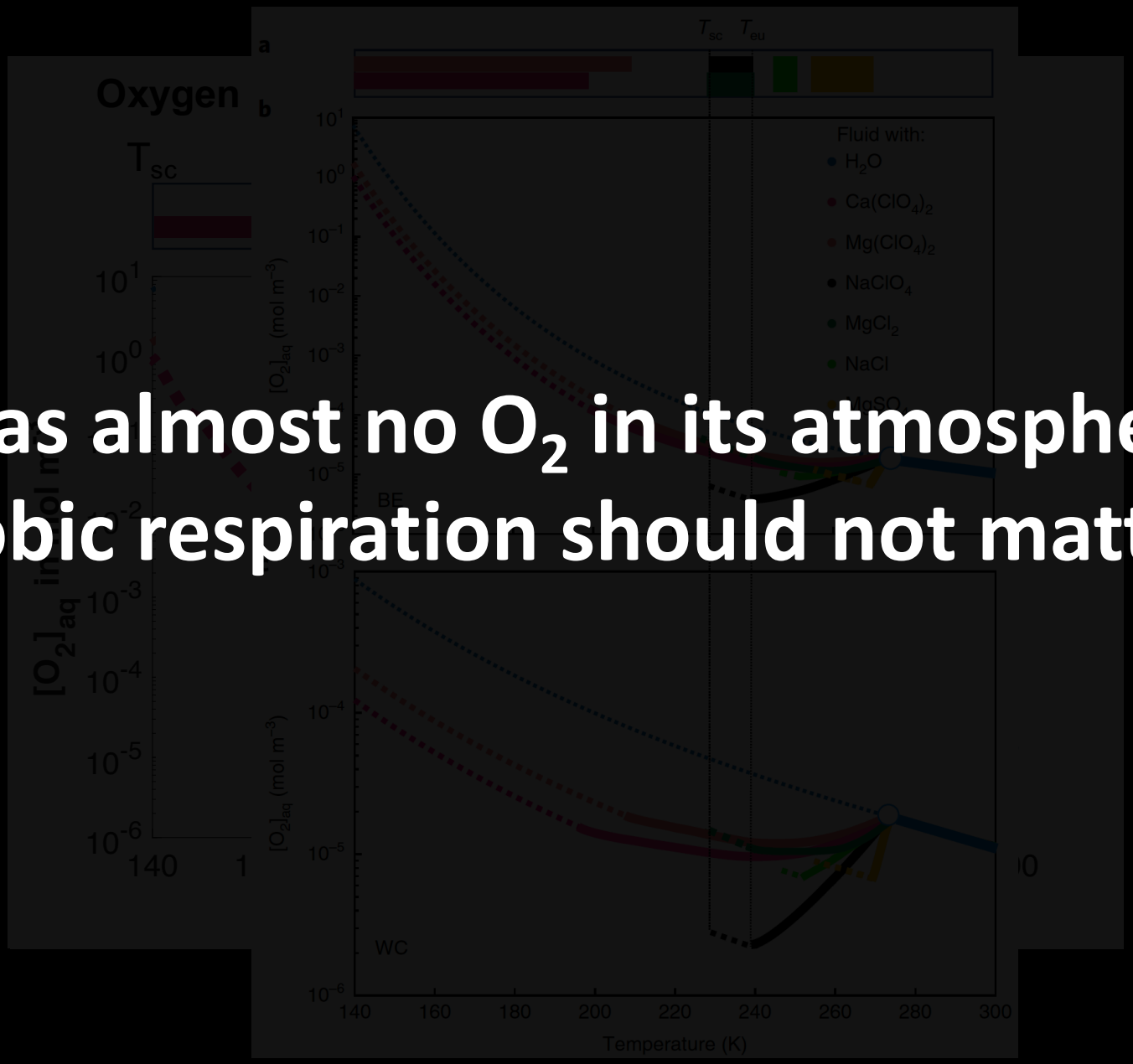
Aerobic Mars?

How to explore it?



Summary

Shallow subsurface brines and O_2
solubility as a function of temperature

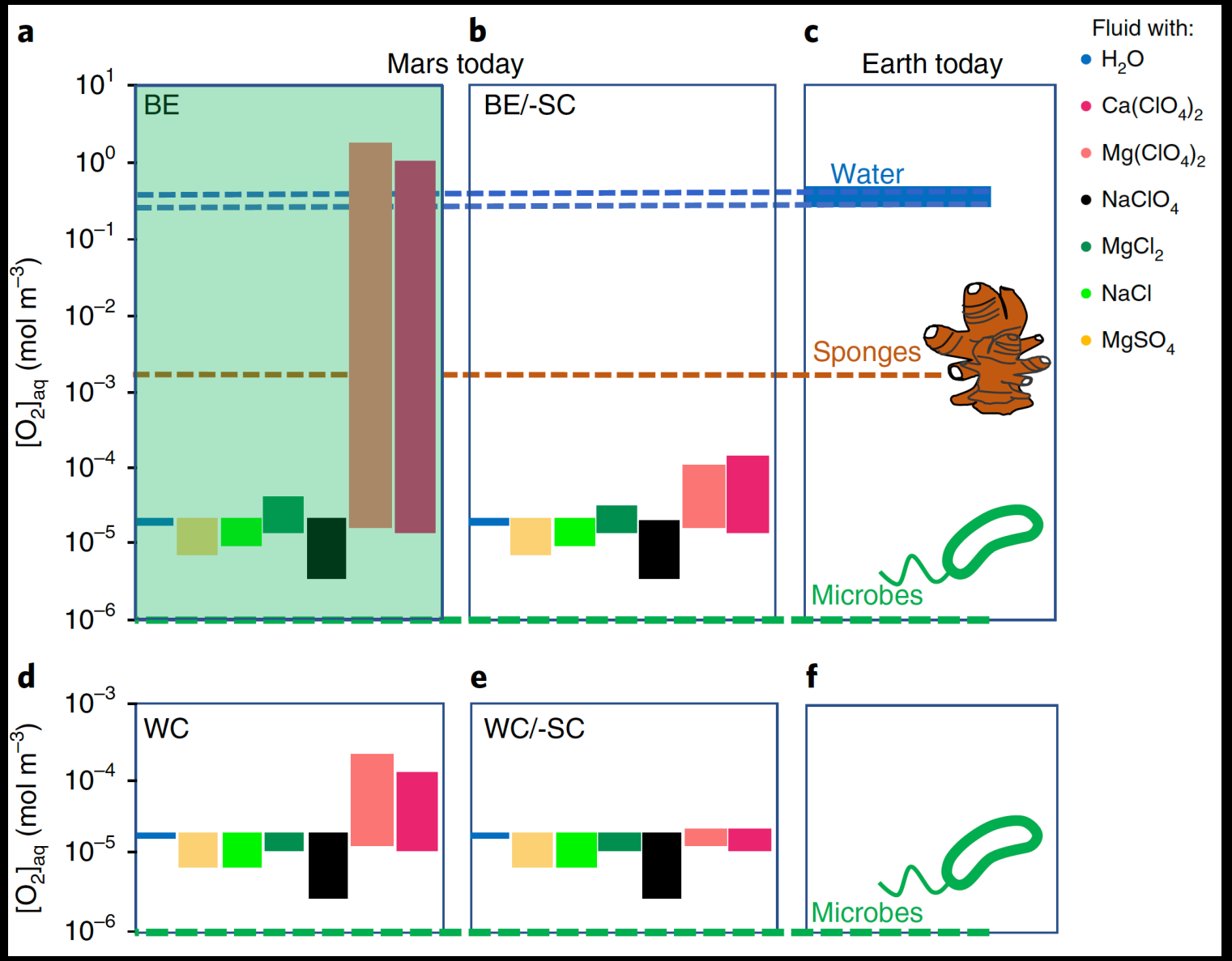


Mars has almost no O_2 in its atmosphere today, so aerobic respiration should not matter, <u>right</u>?

Stamenkovic et al., Nature Geo (2018)

- P = 6 mbar
- T = 140-300 K
- Shallow subsurface

Shallow subsurface brines and O_2
implications for aerobic life



Stamenković +, Nature Geo (2018)

Shallow subsurface brines and O_2

today in 3D…(& also in ancient times?)

Solubi

O_2 solubility in Ca-perchlorate brines

Evidence of large $[O_2]_{aq}$ from MnO_2?

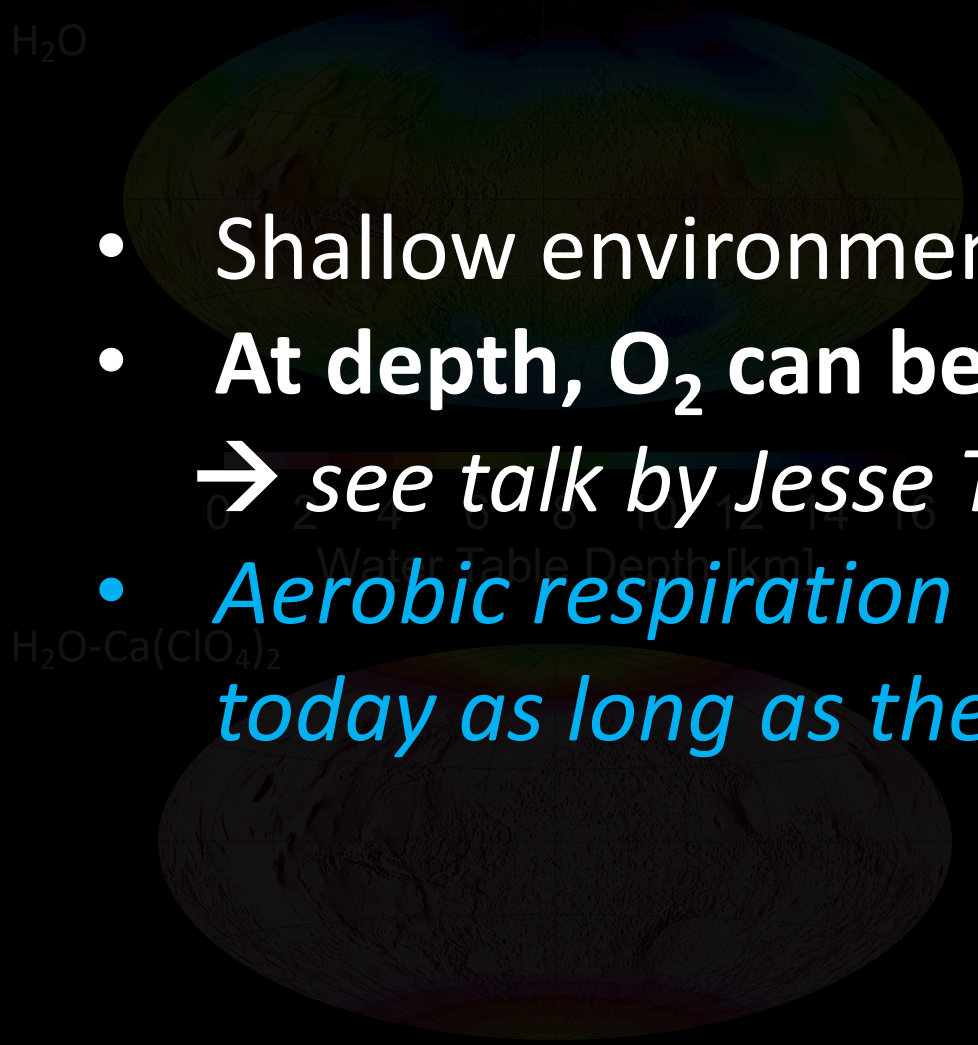
$\log_{10}([O_2]_{aq})$

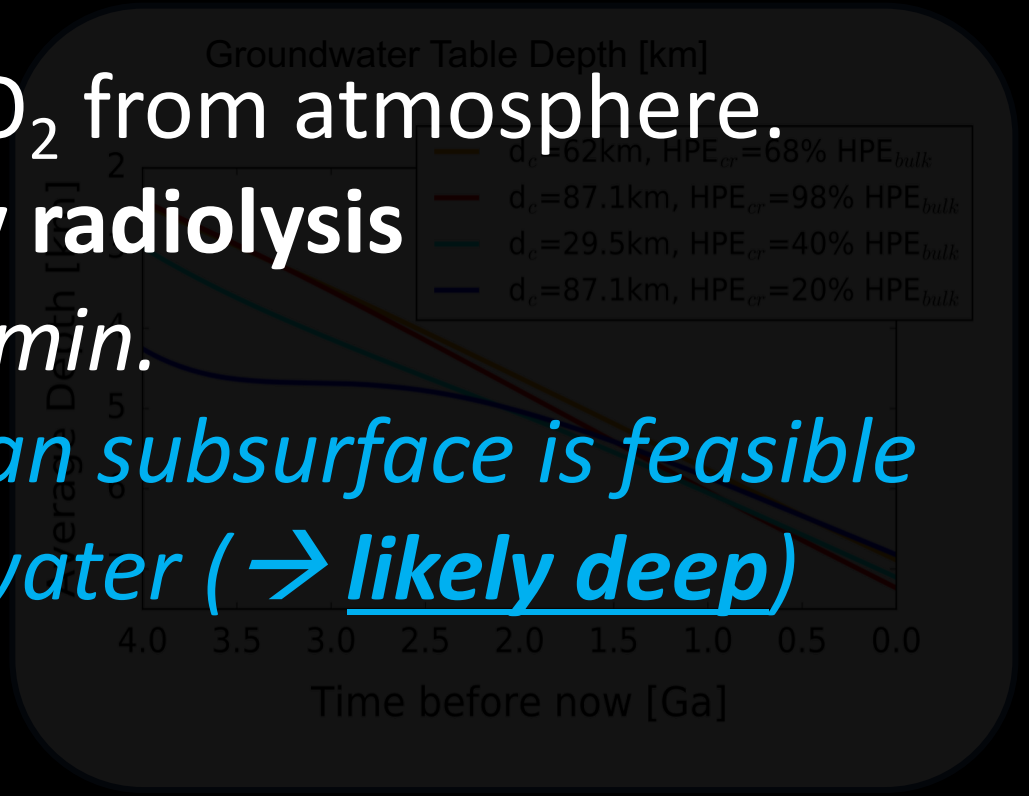
Evidence that early Mars was more similar to today?

Stamenković +, Nature Geo (2018)

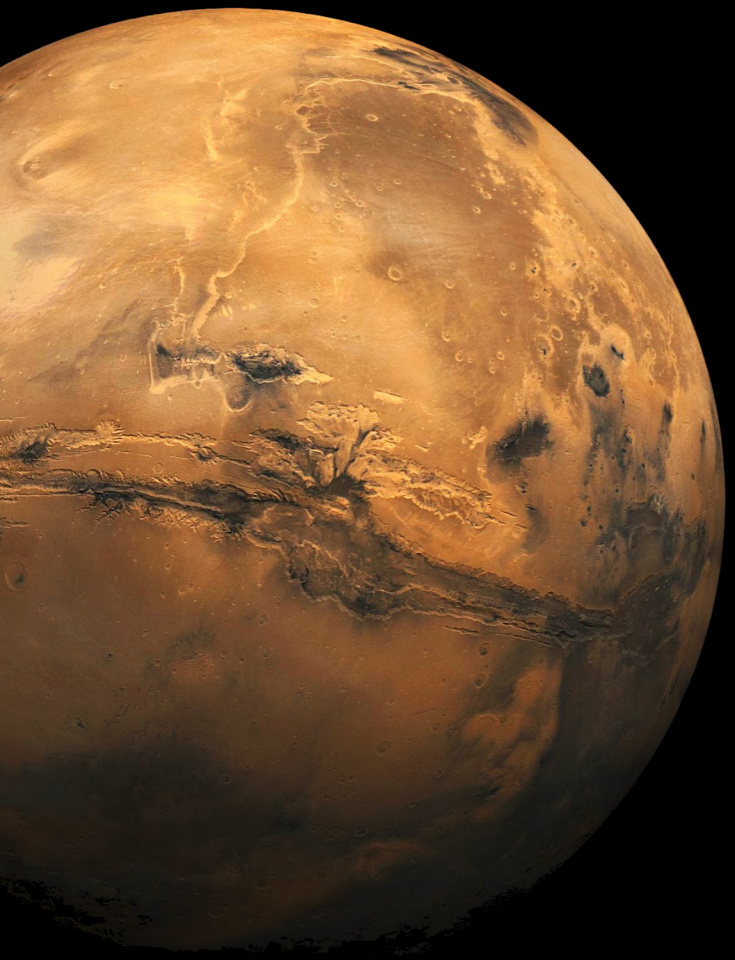
We need to have liquid water

and that's likely deeper today (& in ancient times?)

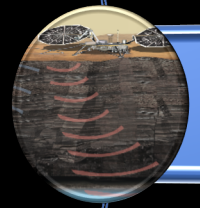




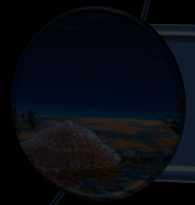
- Shallow environments can get O_2 from atmosphere.
- **At depth, O_2 can be supplied by radiolysis**
  → *see talk by Jesse Tarnas in 30 min.*
- *Aerobic respiration in the Martian subsurface is feasible today as long as there is liquid water (→ **likely deep**)*



Aerobic Mars?



How to explore it?

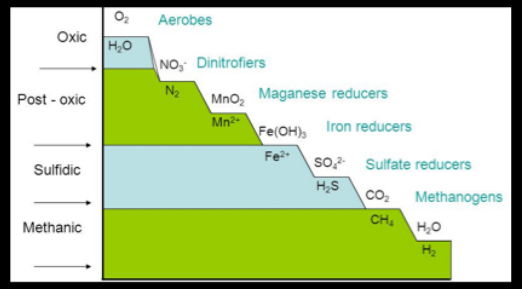


Summary

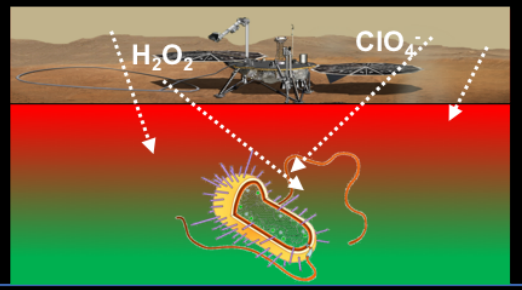
VALKYRIE* concept: subsurface habitability as a stepping stone

*Volatiles And Life: Key Reconnaissance & In-Situ Exploration

- A. Liquid Water

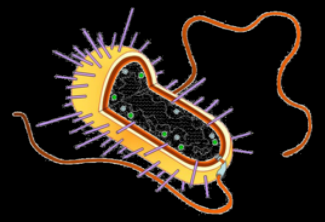


- B. Energy & Nutrients



- C. Cellular Stability

1. HABITABILITY



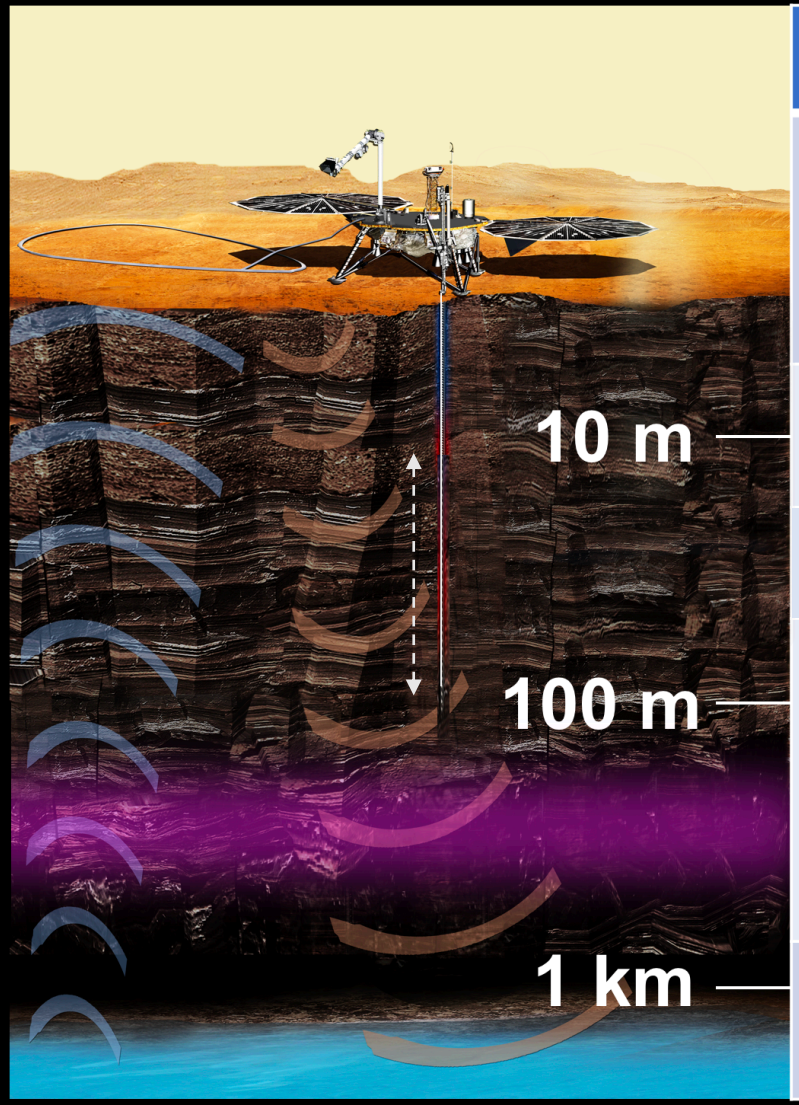
- D. Biomarkers & Signs of Metabolic Activity

2. LIFE

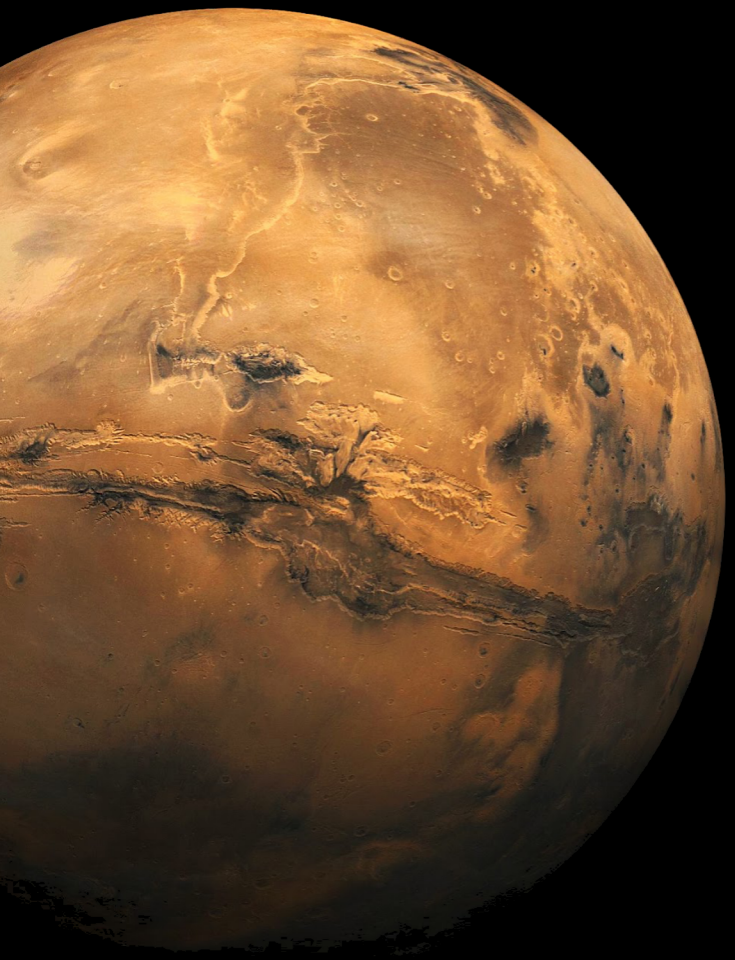
MARS CIFAR Earth 4D

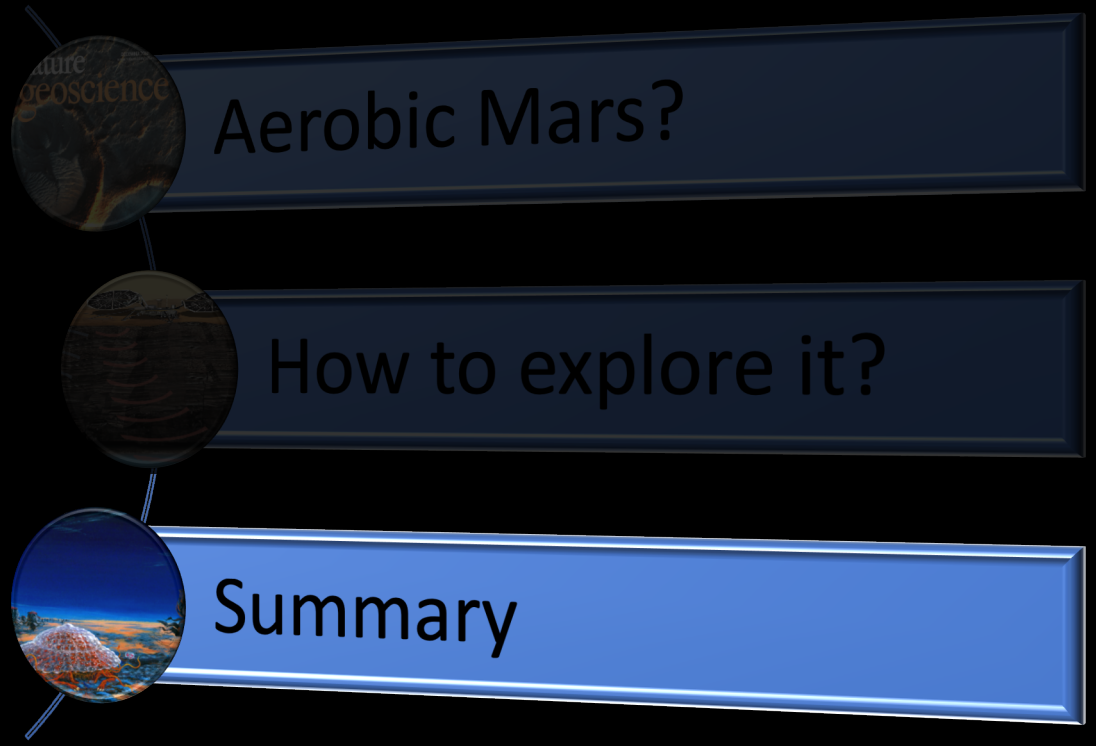
VALKYRIE* concept: subsurface habitability as a stepping stone

*Volatiles And Life: Key Reconnaissance & In-Situ Exploration



Technology	TRL	Rational to Support TRL Claim	Lab Demo Field Demo
Water: Transient Electromagnetic Sounder. Ballistic Loop deployment.	4	Based on existing technology that has been used for over 40 years. Mars TEM systems are being developed.	Yes. Started.
Heat: Thermal Probe	8	Based on existing technology used on Earth. Simple, robust.	Yes. Yes.
Subsurface Access: Drill (10-100 m)	5-6 4	PDD, AG2, & many more ASGARD	Yes. Yes. No. No
Geobiochemical Analysis: • Trace Gases. • Radiometer. • UV/Raman Spectrometer • GC-MS • Optical microscope	8-9	All successfully flown on MSL or being prepared for Mars 2020.	Yes. Yes.
Surface Constraints: • Met Station • Camera	9	Successfully flown on Phoenix, MSL	Yes. Yes.

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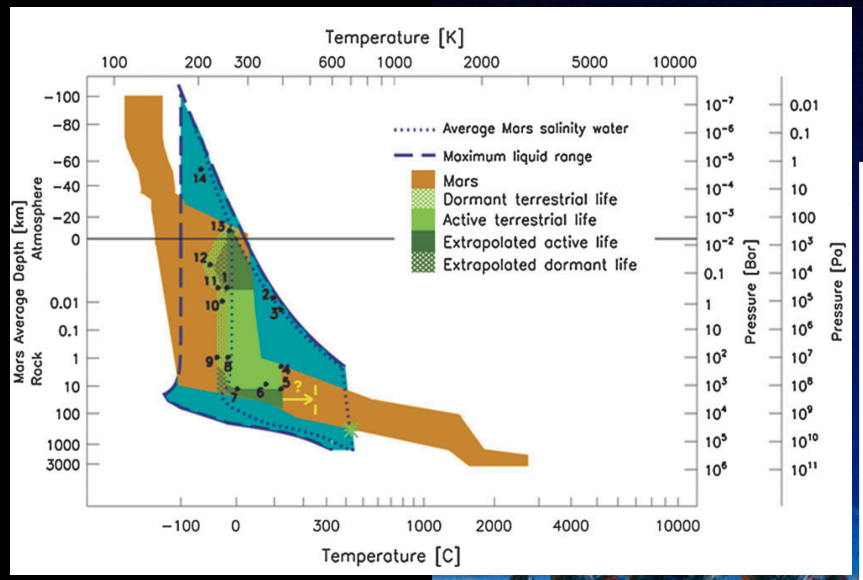
How to explore it?
Summary

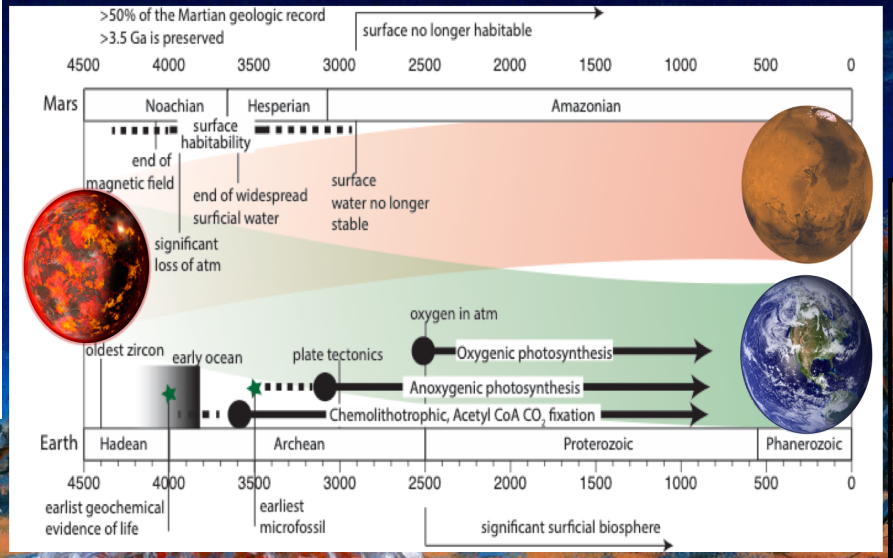
Summary: the Martian deep subsurface

1-on-1 terrestrial habitat analog



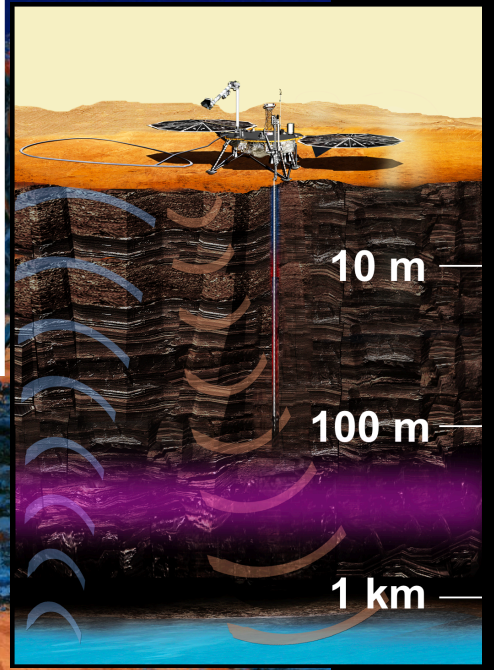
Jones + (2011)

longest living habitat



By Haley Sapers (2019)

Ready to be explored



National Geographic (1967)

A new planet

O_2